

INCIDENCE OF A TREMATODE, *DIPLOPROCTODAEUM*  
*Plicitum* (LINTON, 1928) IN THE PUFFERFISH,  
*URANOSTOMA RICHEI* (FRÉMINVILLE, 1813)

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ABSTRACT

The trematode, *Diploproctodaeum plicitum* is drawn and synonyms are listed. Species of this genus have only been found, to date, in pufferfishes. *D. plicitum* in *Uranostoma richiei* is a new host record for this species of trematode.

*U. richiei* were collected from Lyttleton Harbour, Christchurch, to examine the incidence of *D. plicitum* infection. Twenty-eight per cent were infected, with no significant difference in rate between male and female hosts. Highest infection was in the anterior portion of the intestine, and in age groups 1+ to 4+. Mean length of *D. plicitum* was highest in the 2+ host age group, and declined in older fish. The possible causes of this maximum parasite length in young fish and subsequent decline, are discussed in terms of inferred patterns of infection.

INTRODUCTION

The trematode (Fig. 1) found in the pufferfish, *Uranostoma richiei* (synonyms are *Contusus richiei*, *Spheroides richiei*, *Tetrodon richiei*) family: Lagocephalidae, belongs to the genus *Diploproctodaeum* La Rue, 1926 which has been the source of much taxonomic and nomenclatorial confusion for the last 30 years. Sogandares-Bernal and Hutton (1958) discussed the taxonomy of the genus and pointed out that the genus *Bianum* Stunkard, 1930 is synonymous. The trematode in this paper is similar to that described by Stunkard (1931) as *Bianum plicatum* from the intestine of several species of pufferfish, and to *B. adplicatum* Manter, 1940 from *Cheilichthys annulatus* and *Spheroides augusticeps*. The only difference seems to be that of size, the longest found in this study was 4.4 mm, whereas Manter's longest was 2.5 mm (Manter 1940). This was probably due to the much larger sample than Manter's five hosts. The genus is unusual in that the gut caeca have anal openings and all species of the genus to date, occur in pufferfish.

Superfamily Lepocreadiidea Cable, 1956  
Lepocreadiidae Nicoll, 1934  
*Diploproctodaeum plicitum* (Linton, 1928); Sogandares-Bernal and Hutton, 1958.

Synonyms:

*Distomum* sp. of Linton, 1898 and 1905  
*Psilostomum plicitum* Linton, 1928  
*Bianum concavum* Stunkard, 1930

*Bianum plicatum* (Linton); Stunkard, 1931

*Bianum adplicatum* Manter, 1940

Host: *Uranostoma richiei* (Fréminville, 1813)

Location: Intestine

The aim of this study was to determine the occurrence and incidence of the parasite and also the relationship of the parasite to the host. The host biology has been described by Habib (1971).

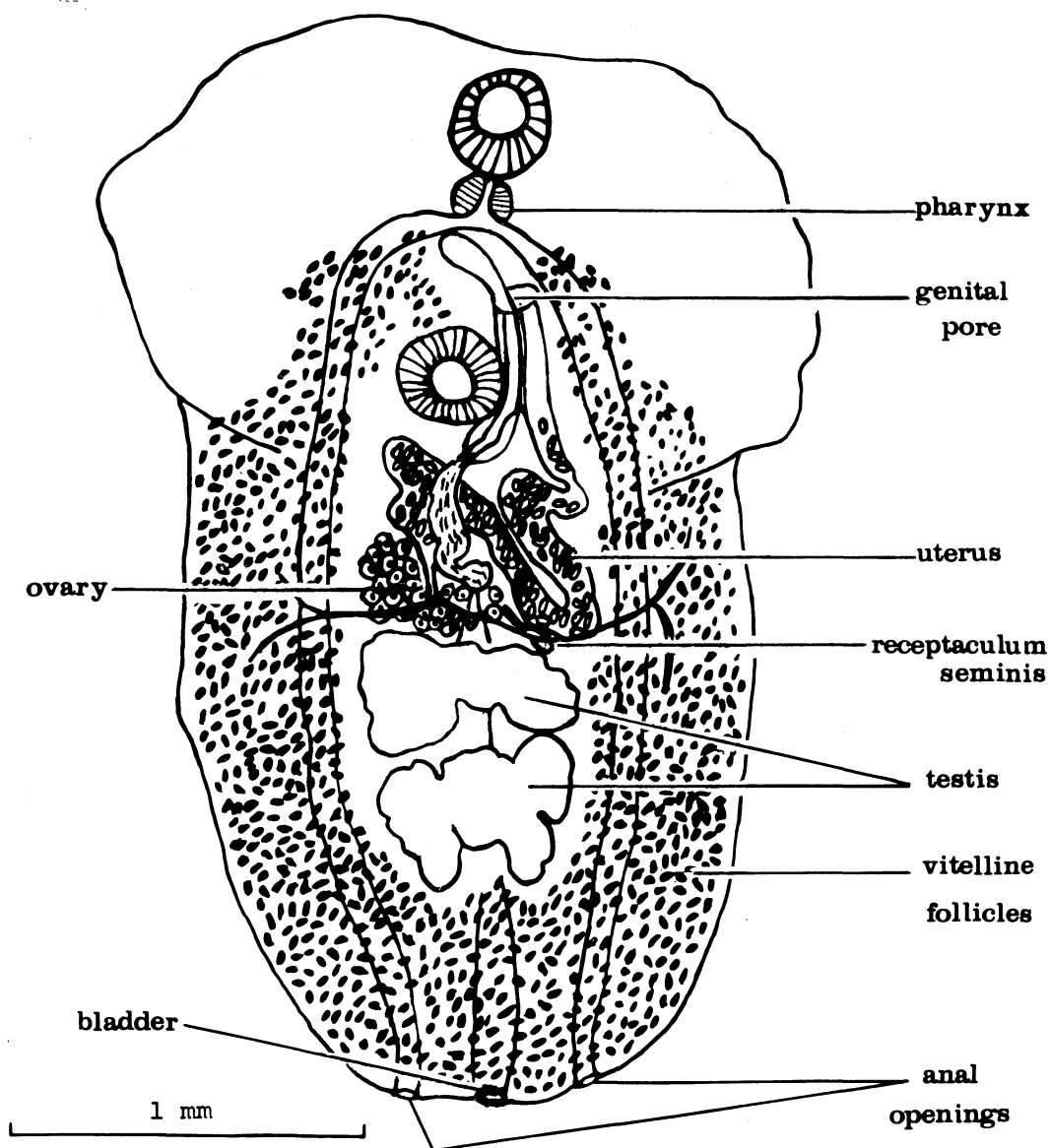


Fig. 1. *Diploproctodaeum plicatum*.

## METHODS

During the non-breeding season between March and June 1970 (G. Habib pers. comm.) 1007 pufferfish were obtained from Lyttelton Harbour. All fish were dissected and their gut contents examined. The length and sex of each fish, and the numbers, locations and lengths of all trematodes were recorded. Host age was calculated from length measurements utilising a relationship shown by Habib (1971) (Table 1).

TABLE 1. LENGTH RANGE OF HOST AGE CLASS

Age class	Length range (mm)	
	Female	Male
1+	40 - 70	40 - 65
2+	71 - 110	66 - 80
3+	111 - 130	81 - 100
4+	131 - 140	101 - 110
5+	141 - 153	111 - 120
6+	154 - 170	-
7+	171 - 180	-

Trematodes not prepared for mounting were fixed in 70% alcohol. Eggs were obtained from live trematodes but attempts to hatch these at approximately 18°C in dishes in which sea water was replaced every few days and in an aquarium, were unsuccessful.

Twelve crabs (*Hemiplax hirtipes*) commonly found in the host's stomach contents, were dissected and examined, but no intermediate stages of *D. plicatum* were found.

## RESULTS AND DISCUSSION

Of 1007 pufferfish examined, 283 were infected (28%) and 729 *D. plicatum* were collected. Rates of infection in 653 females and 354 males were not significantly different.

*D. plicatum* occurred throughout the intestine of the pufferfish but was more concentrated in the anterior third (Table 2).

TABLE 2. LOCATION OF *D. PLICATUM* IN THE HOST INTESTINE

Position in host intestine	No. present	% of total <i>D. plicatum</i>
Anterior third	593	61
Middle third	342	32
Posterior third	72	7

There was no morphological differentiation along the intestine, and intestine length was 30-160 mm. This concentration in the anterior portion is probably related to a greater availability of food.

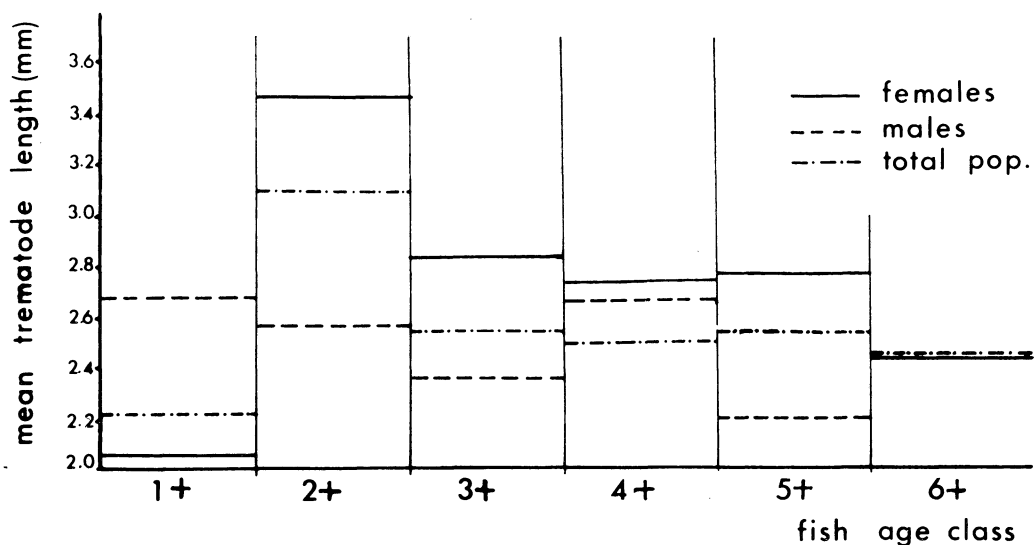


Fig. 2. Mean length of *D. plicatum* in each host age class.

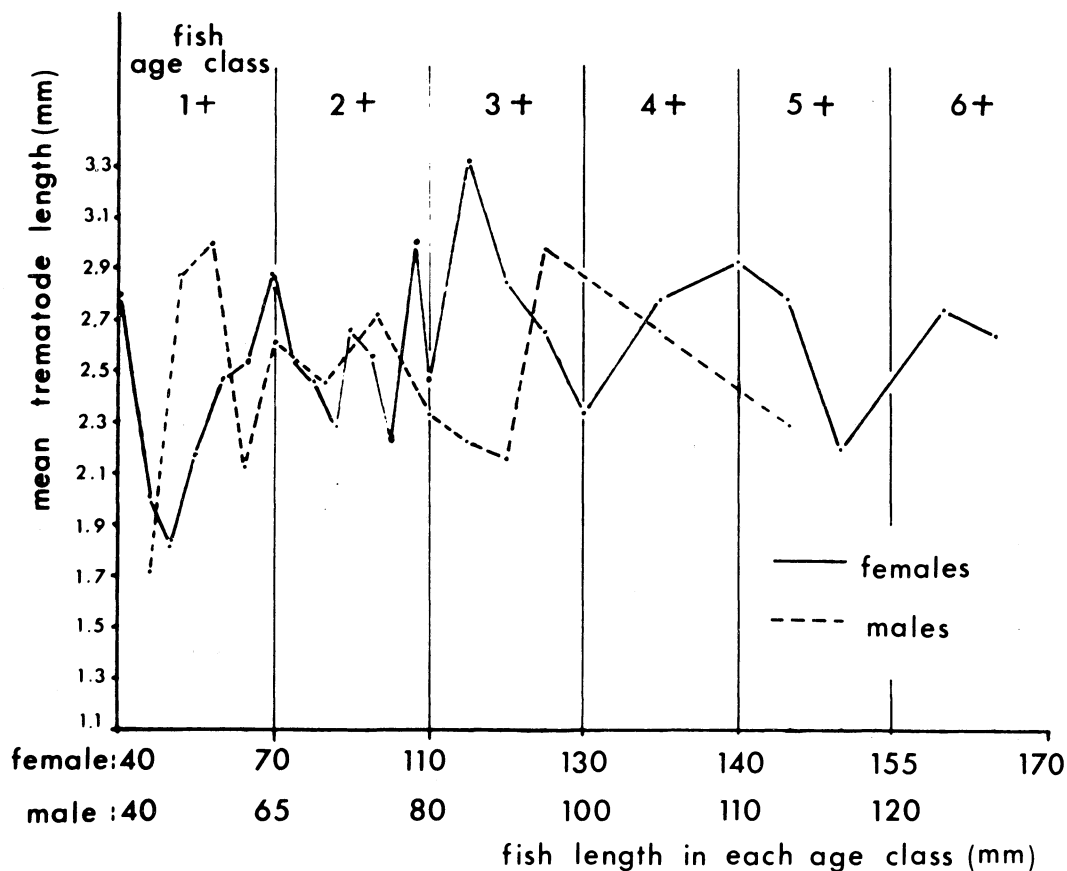


Fig. 3. Mean length of *D. plicatum* with length of host. Age class divisions are also shown for comparison with Fig. 2. The length range of host for an age class differs between males and females.

*D. plicatum* incidence with host age, and degree of infection in each age class, were normalised so that direct comparisons could be made between age classes despite the disproportionately high number of fish in the 2+ and 3+ classes (Table 3). The highest percentage infected, and the highest number of *D. plicatum* per fish occurred in the 2+ age class, but the highest number of *D. plicatum* per infected fish occurred in the 4+ age class. The 4+ class, however, had the lowest percentage infected, with a low percentage infection in older age classes. The increasing percentage infected and decreasing degree of infection with host age may indicate a possible immunological host response to reinfection.

TABLE 3. INCIDENCE OF *D. PLICITUM* INFECTION IN EACH HOST AGE CLASS

Age class	Total no. fish	% infected	No. <i>D. plicatum</i>	<i>D. plicatum</i> per fish	<i>D. plicatum</i> per infected fish
1+	188 (0.41)	19.2 (0.56)	89 (0.21)	0.47 (0.51)	2.45 (0.91)
2+	459 (1.00)	34.4 (1.00)	427 (1.00)	0.93 (1.00)	2.61 (0.96)
3+	212 (0.46)	29.1 (0.85)	149 (0.35)	0.70 (0.76)	2.48 (0.91)
4+	69 (0.15)	15.6 (0.45)	27 (0.06)	0.39 (0.42)	2.72 (1.00)
5+	48 (0.11)	23.0 (0.67)	24 (0.05)	0.50 (0.54)	2.18 (0.81)
6+	31 (0.02)	25.8 (0.75)	13 (0.03)	0.42 (0.45)	1.62 (0.60)
Totals and means	1007	28.11	729	0.72	2.78

Numbers in parentheses represent normalised data.

The highest mean length of *D. plicatum* occurred in the 2+ host age class and a gradual decline in length occurred in trematodes of older fish (Fig. 2). The large increase in mean length of trematodes between the 1+ and 2+ classes coincides with the greatest host growth rate period which may provide the best conditions for growth of *D. plicatum*. If *D. plicatum* remained with its host until the host died, trematode lengths would be expected to increase with host age. In this sample the mean lengths decreased with host age after the 2+ class suggesting that either the trematodes became smaller or reinfection occurred. The general trend of trematode lengths for the total fish population is very similar to the female trend, but the male fish are showing a quite different trend. This may reflect the much higher number of females dissected, or the different rates of growth between male and female pufferfish (Table 1).

When trematode length is examined in relationship to host length in each age class (Fig. 3) the overall trend of Fig. 2 is obscured. This probably indicates a continual parasitisation of fish throughout their lives, with an underlying 2-year 'cycle' in the trematode. The recovery of small trematodes from all age classes indicates continual infection. If hosts are infected in their first year then the peak in trematode length in the 2+ age class may imply a 2 year life span of *D. plicatum*. Loss of this initial infection, immunological host response to reinfection or physiological changes in older hosts related to a slower growth

rate, would cause an apparent subsequent decline in mean trematode length in older fish. The smallest fish dissected (40 mm) was infected with a mature trematode 2.8 mm long. This is longer than the average (2.5 mm) indicating an early infection. The shortest trematode (0.9 mm) was found in a 2+ class fish.

No immature trematodes were recovered from the crabs eaten by pufferfish. In all *D. plicatum* eggs were present, and this absence of immature trematodes could result from trematodes maturing before the host's entry to Lyttleton Harbour, or from the growth rate of metacercarial *D. plicatum* being too rapid to permit collection of the usual number of stages (Smyth 1966). As the trematodes varied considerably in length (0.9-4.4 mm) growth would seem to continue after maturation.

Continual infection implies that the hosts are continually exposed to the source of infection. The source could be either at the breeding grounds outside of Lyttleton Harbour to which the fish return between November and February (Habib 1971), or within Lyttleton Harbour, or at both locations. Examination of immature fish first arriving from the breeding grounds about September, and a further search of possible intermediate hosts will be necessary to establish the source of the infection.

This parasite appears to have no serious effects on its fish host as, in two 2+ age class hosts, over 20 trematodes were recovered from each. On the other hand, the low number of hosts with such high numbers of trematodes may suggest that a particular parasite load can cause mortality, particularly when influenced by other environmental factors.

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